Fermilab
FY2004 Self-assessment
Process Assessment Report
For
Technical Division

01-Mar-2004

Division/Section performing assessment

Technical Division

Name of organization that owns assessed process

Engineering & Fabrication Department, Process Engineering Group

Organization Strategy

The mission of the Engineering & Fabrication Department is to service the High Energy Physics field in the areas of engineering and fabrication. As such, the EF department manages many jobs in support of the Fermilab accelerator complex. As part of project management, the department provides monthly updates on progress and estimates for completion on the highest priority jobs.

Names of Personnel on Assessment team

Jamie Blowers, Quality Assurance Officer

Name of process assessed

The technical aspect of the monthly job updates

Brief description of process to be assessed

Each month the Project Coordinator runs time and cost reports. This process entails running the web-based Business Services reports, as well as time reports from the TDCharge database, and loading the data into the 'project tracking spreadsheets'.

Are metrics associated with this process? If so, what are they?

There are no contractual metrics associated with this process.

What are the names of the procedures associated with this process?

The procedure associated with this process is TD-2060 Project Management of Fabrication Jobs (currently in draft form).

Are these procedures being followed? Are they current?

This procedure is currently in draft form, and so is being updated as the overall process is continually developed.

Describe the methodology used to assess this process.

This process was assessed through conversations with the Project Coordinator, and through demonstrations of current practices.

Results of the assessment:

As a result of the assessment, this process is given an overall rating of **good**. The work was getting done on-time and with a high degree of data reliability. The Project Coordinator has worked out a reasonable system for making sure that the updates are done accurately. This system, however, entails running and printing the financial reports from Business Services, the time reports from TDCharge, and then loading the data by hand into the project tracking spreadsheets for internal use. This process is labor intensive, and it requires a high level of diligence to ensure data reliability when doing data entry by hand. The major opportunity for improvement is to leverage current technology to automate this process as much as possible (see below).

Identified opportunities for improvement

With the exception of the monthly estimates to complete the work, all the other data used for reporting is in an electronic database (i.e. time data is in TDCharge, which is an MS-Access database, and the financial data is in the Oracle Financial database). The data in these database should be able to be pulled out electronically and loaded into the project tracking spreadsheets with little or no hand data entry. It is understood that this will take a bit of time and effort to implement, but the return on this investment would be very high in efficiency and data reliability.

In addition, the draft policy TD-2060 should be reviewed and approved.

Schedule for implementation of improvements

The process to automate the data collection was completed during March and April of 2004, and went live for the June reporting period.

It is expected that the policy TD-2060 will be approved in the first half of FY05, after the fall shutdown.

Status of improvements from previous assessment

N/A

Attachments (supporting data, worksheets, reports, etc.)

Notes from the assessment

Draft policy TD-2060 Project Management of Fabrication Jobs

Notes for TD-2004-01 assessment on project tracking:

The current process entails the following:

At the beginning of each calendar month (usually by the fifth business day), TJ runs the "Task Summary Report" for each job to be reported. The output from this is printed and the cost data are entered by hand into the appropriate job tracking spreadsheet. In parallel, TJ runs reports from TDCharge, and time data are entered by hand for each person who worked on each job to be reported.

These job tracking sheets are then distributed to group leaders, and they are responsible for generating estimates to complete, and sending these estimates back to TJ so they can be entered by hand into the summary sheets.

After this is all done, TJ then creates charts and summary data, and we get together to review the data.

Proposed process:

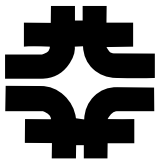
Using a copy of TDCharge (made at the end of each month after LaDaune has approved the data), create queries to generate the necessary time data for each job to be reported. Since the job tracking sheets are in MS-Excel, and TDCharge is MS-Access, the time queries can be linked to each job tracking spreadsheet, and the time data can be automatically loaded each month (i.e. the end result is that TJ simply needs to run the query in each spreadsheet and the data are automatically loaded).

Regarding the financial data, we are able to create ad hoc reports using "Discoverer". Using that tool, we should create the appropriate queries to acquire the necessary financial data each month, and then save the report to MS-Excel. That report can be linked to the job tracking sheets, and so the data can be automatically loaded.

The only dataset which then still needs to be entered by hand are the estimates to complete. It is proposed that these data are entered into MS-Access and linked to each job tracking spreadsheet. This way all the data will be available at any time.

Results:

Jamie Blowers worked with TJ Gardner over several months and the result is that the new system went live in June 2004. It has resulted in a huge time savings for TJ, which should allow him to spend more time maintaining project schedules. This should be considered a major improvement for our Department and Division.



Fermi National Accelerator Laboratory

Technical Division

Project Management of Fabrication Jobs

TD-2060

Version 1 - DRAFT

Authored, TD Quality Assurance Officer	Date
Reviewed, TD/Customer Liaison	Date
Reviewed, Engineering & Fabrication Head	Date
Reviewed, Development & Test Head	Date
Reviewed, Material Control Head	Date
Approved, Technical Division Head	Date

Revision History

Version	Date	Section No.	Specifics
1	20-Jul-2004	All	First version

Controlled Distribution

Technical Division Library

Introduction

Background

The Technical Division was originally organized as the Technical Support Section in the early 1980s. It was at this time that Technical Services (consisting of the Conventional Magnet Facility and the Machine Shops) and the Energy Saver Section (consisting of the Superconducting Magnet Facility and the Magnet Test Facility) were combined to create the Technical Support Section. In the mid 1990s a reorganization of the laboratory occurred and the Technical Support Section became the "Technical Division". Although research was a part of the work as a section, the change to become a division made research a major portion of the mission of the organization.

The Technical Division maintains a diverse work force that has a very wide range of core competencies. In support of the R&D the division has experts in the fields of engineering, fabrication, tooling, machining/welding, procurement, calibration, testing, operations, maintenance, QA/QC and systems integration. The division also provides services in project management, project planning, resource management and scheduling. The Technical Division is heavily involved in the work of repairing and refurbishing existing devices, as well as design, fabrication and project management of a wide variety of HEP projects, including the next generation of particle accelerators, detectors, and astrophysics experiments.

Project Management

Due to the level of complexity of the work done in the Technical Division it was decided to implement a formal, documented program, which describes the practices used by the division to plan fabrication projects. The methods used by the division are based on standard project management tools.

This document defines division policy and overall procedures for the organization. Although it covers the entire system, it is not meant to describe every detail of the system. Some details are left up to the discretion and competence of the people working within this system.

The purpose of the system is to aid the division in meeting the needs of our customers. This is accomplished by applying systematic thinking and planning to the work that we do, and maintaining a good level of communication both internally within the division, and externally with our customers. In using this system, we also track our actual work versus our estimates. This allows us to find areas in which we do very well, and areas in which we should improve.

Our desire is to have all division employees constantly challenge and push our activities to higher levels of performance, which enables us to continually innovate, improve, and learn. We strive to continually learn and improve in all that we do, which includes this system.

1.0 Purpose

The purpose of this document is to formally issue and institutionalize this project management system. It is meant to describe the system, and is not intended to be a work instruction that describes every detail of the process. This document can be used as a reference tool to aid the user in understanding how we do the business of project management.

This system is meant to evolve as the need arises. Please contact the TD Quality Assurance Manager with feedback on this system, and with any ideas on how to make it better.

2.0 System Scope

The scope of this system is the design, planning and implementation of fabrication, or potential fabrication, projects. Fabrication can include making new devices as well as repairing or upgrading old devices.

3.0 Mindset

Fermilab has developed a culture that tries to foster creativity and freethinking. These are two strengths of our culture, and of the people that work at the Laboratory. These strengths, however, can work against attempts to systematically define a methodology of work. In essence, this mindset makes it difficult to implement a project management system. We are much more comfortable when we "shoot from the hip", than defining responsibilities and schedules. However, just by being aware of this mindset, we are then in a position to begin the process of changing that mindset, and our culture. And we acknowledge that, until we begin the work of changing our minds, this system will not function to its potential.

4.0 Mechanics

It was identified that there is a need to keep track of three types of data: schedule data, cost data and project-specific data. To this end, we use three pieces of software to keep track of these data. It is conceivable, after becoming more proficient with MS-Project, that these three systems will be merged into one. However, at this time it is easier to use MS-Project for keeping track of schedules, use MS-Excel to keep track of cost, and use MS-Access to keep track of all other project information.

4.1 Microsoft Project

MS-Project is used in TD to keep track of individual project schedules, and for combining the individual schedules into an integrated schedule. MS-Project was chosen because of its previous use within TD, for its ease of use, and for its cost.

4.2 Microsoft Excel

MS-Excel is used to keep track of project costs and estimates to complete, as well as for reporting project data and status. In order to ensure consistency, we have created templates which are used for all fabrication projects. Examples of these templates are attached.

4.3 Microsoft Access

There is an ongoing effort to migrate most data management into MS-Access. At present we utilize MS-Access to track all project data that is not related to costs. We then use MS-Excel, html, or some other format to publish reports from the database.

The following lists some of the information maintained in the project data database. We note that this is not intended to be a complete listing, as the project database is regularly "tweaked" with improvements. This list, instead, is intended to provide a basic understanding to the reader of what it is that we track:

Job Number -
Project Name -
Descriptor - e.g. EDBB, TSHH
Description of work -
Quantity Needed -
Serial Numbers completed - used to state number of devices completed
Date Requested -
Priority - set by the customer
Scheduled Completion Date -
Project/Task Numbers -
Estimated Cost -
Final Cost -
Customer Contact Information -
Project Engineer contact information -
Existing device IDs -
Assembly drawing number -
Traveler number -
Job History – this could include links to meeting minutes and other such updates in job status

5.0 Methodology

Although we utilize standard project planning techniques, we thought it important to document a few of the specifics for communication and training purposes.

5.1 WBS Thinking

WBS, which stands for Work Breakdown Structure, is a *deliverable-oriented grouping of project elements which organizes and defines the total scope of the project*. It is good to think in terms of a WBS when planning the work. This will help to ensure that all the appropriate project elements will be thought about and included in the schedule and cost estimate.

Our practice is to organize the schedule by grouping tasks together. For example, all tasks that are related to design are placed together in the schedule, and all tasks related to procurement are placed together in the schedule. This means that the tasks may not be laid out in chronological order. By placing tasks together in this way, we are in a better position to judge whether or we have addressed all the needs (i.e. WBS thinking) and that we have allowed enough time to get the work done.

5.2 Standard Milestones

In our project scheduling process, we make a practice of including standard milestones. These serve as a template when creating the project schedule. Of course, these can, and are, adjusted as needed to meet the requirements of the specific projects.

Preliminary Design Review(s) - The primary purpose of preliminary design reviews is to present and agree to design requirements. Design requirements are then translated into actual designs.

Final Design Review(s) - The primary purpose of final design reviews is to present and agree to the actual design. The Project Engineer presents drawings that describe how the design requirements have been met.

Readiness Review(s) - The primary purpose of readiness reviews is to ensure that Engineering & Fabrication is ready to begin production. This entails the review and publication of drawings, travelers, tooling and parts. We also ensure that a Device Service Record is created for each device (refer to TD-2030 Device Data Management).

5.3 Task Durations

We do not want to present schedules that are too tight to fulfill. Because of this, in general, task durations are defined as "worst-case" scenarios. We also incorporate certain tasks into the schedule to demonstrate what could happen, but may not happen. Examples of this may be to include time in the schedule for adjusting a lamination die after the sample laminations have been measured, or to include time for re-machining a solid core after a first article has been magnetically measured.

5.4 Initial Estimates

Providing an initial schedule and cost estimate is important in that they are needed by the customer so that they can decide how to best spend their resources. These types of estimates are generally based on a rough WBS and prior experience, and may be done by the Project Engineer or by the group leaders. Typically 50% contingency is placed on initial estimates.

Factors to remember when creating estimates:

- Startup efforts (e.g. work to design the magnet and tooling, work to create the travelers, work to setup the tooling);
- Ongoing operations (e.g. time spent on production floor to assist in the fabrication process, time spent to address DRs);
- Meetings (e.g. time spent internally or with the customer at status update meetings);
- "Head scratching" (e.g. time spent thinking about issues and waiting for feedback from the customer).

5.5 Establishing the Project Baseline

In an effort to define reasonable commitments, a baseline is set for each project schedule and cost estimate. Actual progress will be compared to the baseline. In this way, we will track our progress towards our commitments, as well as learn to improve our project planning methodology.

The question is, when do we set the baseline? In principle, the baseline is set when we have reached an appropriate level of comfort with the data. This comfort level is normally reached after many iterations between the Schedule Coordinator and the other project personnel, and should occur at some point prior to starting fabrication. Typically 10-25% contingency is placed on baselined estimates.

5.6 Establishing a Re-Baseline

As a project implementation proceeds, sometimes we find that we cannot meet the schedule and/or cost baseline. This can happen for various reasons, including design changes, scope changes, as well as reevaluation of labor estimates based on the experience of working on the project tasks. Whatever the reason, some projects will require the schedule and/or cost to be re-baselined. This is important for both TD and the customer, so that we accurately reflect the requirements and commitments of the project.

The question is, when do we re-baseline the schedule? In principle, the baseline is changed when we have collectively decided that a change is necessary. Factors that will most likely necessitate a re-baseline include:

- A change in project requirements;
- A change in project scope;

- A major design change;

Sometimes we may also find that our assumptions for creating the schedule and cost estimates were incomplete or incorrect. And as we track progress we find that we are quite different than our estimates. In this case, it may be necessary to adjust the baseline to take into account what has been learned as the project has progressed. An example of this situation is when we did not factor in time spent waiting for feedback from the customer before proceeding to the next step. If we did not factor this into our estimates, then the simple fact that the project is taking longer will also translate into higher costs. This, typically, warrants a re-baseline.

5.7 Project Tracking

Keeping accurate records of project schedule and cost is very important for each project. Pragmatically speaking, it is necessary due to customer schedule requirements and finite budgets. However, it also serves as a tool to gauge how well we are doing as compared to our estimates. Presently we gather cost data once a month after Business Services updates the Oracle Financials database. At the same time we gather hours worked from the TD effort-reporting database. These data are reported in the project cost template, and each group leader estimates the remaining work for each project. The combination of the actual costs and the future estimates provides our working estimates of the total project cost at completion.

Schedule updates are done throughout the month. This work entails the Schedule Coordinator receiving periodic updates from the Project Engineer and other group leaders.

Factors to remember when updating estimates:

- How much work has already been completed? How much effort did it take to complete this work?
- How much work is yet to be done? Based on our previous experience, how much effort do we expect is needed to complete the work?
- We should be communicating with those who are doing the work to better understand the work completed and the effort needed to finish the project.
- *In order to gauge how much effort is needed to complete the project, we need to understand how much of the project is already completed*.

6.0 Roles and Responsibilities

The project management system involves many interdependent roles. These roles, and their respective responsibilities, are defined below.

6.1 Customer

The *Customer* is the person(s) who have requested the work, and who will receive the deliverables from Technical Division. The customer should provide the following:

- Specific requirements to define the work of the project, which include:
  - Description of work;
  - Quantity needed;
  - Need-by date;
  - Priority, as it relates to other work for the Customer.
- A contact person for coordinating communication on project needs and status;
- Devices to repair or upgrade, as required;
- Project/Task Numbers.

6.2 TD/Customer Liaison

The primary role of the TD/Customer Liaison, as it pertains to fabrication jobs, is to be the central person for communication between TD and the Customer. Most jobs are routed through the Liaison to the TD, and most preliminary information is provided back to the Customer through the Liaison. The Liaison also schedules and runs coordination meetings between TD and the Customer, and is responsible for having the appropriate project/task numbers created or assigned.

As the project progresses, there is a shift from the Liaison to the Project Engineer for communication between the TD and the Customer.

6.3 Process Engineering

Process Engineering is a Group within the Engineering & Fabrication Department. Working with the Process Engineering Group are Traveler Coordinators and the Schedule Coordinator. Their roles are defined as follows:

Traveler Coordinator:

- Working with Production and Engineering to maintain travelers and parts kits for each fabrication project (see TD-2050 for a detailed description of the traveler system);
- Organizing Production Readiness Review(s);

Schedule Coordinator:

- Designing and maintaining the project tracking database;
- Coordinating all work related to each job, which includes:
  - Assigning a job number for each job;

    - Interfacing with all people involved with the project to maintain accurate data related to the project.
- Maintaining the project schedules, which includes:
    - Maintaining a schedule for each project;
    - Interfacing with all people involved with the project to maintain accurate schedules;
    - Integrating all schedules into a master schedule.
- Maintaining the project cost estimates, which includes:
    - Creating the cost spreadsheet for each project;
    - Collecting data from the financial and TD effort-reporting databases, and publishing the data in the cost sheets;
    - Collecting estimates from group leaders and publishing in the cost sheets.
- Issuing reports on project status.

6.4 Project Engineer

The *Project Engineer* is the central figure in the project management system, and so has many roles to fill:

- Along with the Customer Liaison, the Project Engineer is the main contact for communication with the customer, which includes:
    - Working with the customer to define and document project requirements;
    - Providing initial cost and schedule estimates to the customer.
- Providing detailed design drawings for release;
- Reviewing/revising cost estimates as the design matures.
- Providing schedule and cost input to the Schedule Coordinator through regular meetings;
- Organizing Design Review(s);
- Providing all technical input for the creation and use of the traveler(s);

6.5 Production Manager

The *Production Manager* is responsible for the following:

- Providing schedule and cost input to the Schedule Coordinator through regular meetings;
- Allocating appropriate resources to fulfill the schedule requirements;
- Providing input to Traveler Coordinators for the creation and maintenance of travelers;

6.6 Material Control Department

The Material Control Department is responsible for providing procurement, incoming inspection and storage services to the Division and Laboratory. For the purposes of the project management system, the roles of Material Control include:

- Providing design-related input on the use of industry practices for the fabrication of parts/assemblies or other services;
- Procuring and inspecting the parts needed for the project;
- Providing schedule and cost input to the Schedule Coordinator through regular meetings, which includes:
    - Maintaining appropriate information regarding the procurement status of parts needed for the project.

6.7 Magnet Test Facility

The *Magnet Test Facility (MTF*) is operated by the Development & Test Department. MTF is responsible for conducting cold and warm measurements of devices to measure characteristics such as quench currents and magnetic strength & harmonics. For the purposes of the project management system, the roles of MTF include:

- Measuring devices, as required for the project;
- Issuing reports on the results of the device measurements;
- Providing schedule input to the Schedule Coordinator.

7.0 Structure

The overall structure is defined in the process flow diagram (last page).

The process flow is iterative. This means that we continually go through the process of planning, implementing, checking and adapting, until we are finished with the project.

The process flow diagram is a very broad look at the project management process. Following are more details about each of the steps in the process.

It is understood that each step involves updating the information in the Jobfile and/or other project records.

7.1 Request for Work

Remarks:
- Work could involve initial estimates, or other info, as well as fabricating a device;
- Requests for work could be very informal, e.g. a question over lunch. The rule of thumb is if you have to get back to the requester (i.e. you cannot answer the question on the spot), then a Jobfile should be created.

Inputs:
- A need for something

Outputs:
- Job request
- Jobfile

Roles:
- **Customer** - provides the request to TD

- **Schedule Coordinator** - assists the Customer in developing the request, and then assigns a job number and creates the Jobfile

7.2 Decide next step, or Plan

Remarks:
- Project Engineer is assigned to project
- Questions to ask, and answer include:
  - "Is design required, and if so, how much?"
  - "Is engineering effort required, and if so, how much?"
  - "Is procurement required, and if so, how much?"
  - "What are the tooling needs?"
  - "What are the limiting factors?"
- Develop initial schedule, cost estimate and work plan
- Identify meeting routines and project review milestones
- Identify resources needed to complete project

Inputs:
- Job request

Outputs:
- Decisions and plans

Roles:
- **Project Engineer** - coordinates making decisions and plans, based on the job request
- **Schedule Coordinator** - assists Project Engineer in the creation of initial schedule, cost estimate and work plan

7.3 Implement Plan

Remarks:
- Work is done on the project. This may entail gathering information and creating a report, or it may entail design, procurement and fabrication;
- Project data is recorded in the Jobfile and other project tracking systems.

Inputs:
- Job request
- Plans

Outputs:
- Cost and schedule estimates
- Revisions to cost and schedule estimates
- Design specifications and drawings
- Procurement of parts
- Fabrication of device(s)

Roles:
- **Project Engineer** - coordinates all work done on the project
- **Schedule Coordinator** - maintains appropriate records to reflect up-to-date work on project; serves as link between all personnel working on project
- **Traveler Coordinator** - develops travelers
- **Production Manager** - coordinates all fabrication-related work
- **Material Control** - procures and inspects needed parts

- **Magnet Test Facility** - measures devices

7.4 Review work and provide feedback

Remarks:
- On a regular basis, the work on the project is reviewed and compared to the plan;
- Based on the review, the schedule, cost estimate and plans are adjusted as needed;
- Status reports are generated and information is communicated internally within the Division and back to the Customer;
- Reports could take the form of formal reports, e-mail messages, or other formal and informal communications.

Inputs:
- Jobfile
- Tracking database
- Schedule
- Cost estimate

Outputs:
- Updates to schedule, cost estimate and plans
- Report(s)

Roles:
- **Project Engineer** - Works with Schedule Coordinator to review work and update records
- **Schedule Coordinator** - Works with all personnel on project to review work and update records
- **Production Manager** - Works with Schedule Coordinator to review work and update records
- **Magnet Test Facility** - issues report(s) stating the results of their measurements
- **All others** - provide feedback to Schedule Coordinator on work progress

7.5 Project complete?

Remarks:
- In order to closeout the project, we must determine if we have met the requirements of the project. This decision ultimately comes from the Customer;
- Upon review, if it is determined that the project is not complete, then the iterative cycle continues with planning (7.2 above).

Inputs:
- Jobfile
- Tracking database
- Schedule

Outputs:
- Decision to close project or to continue

Roles:
- **Customer** - decides whether or not the project is complete to their satisfaction

7.6 Project closeout

Remarks:
- A final review is completed to compare are actual cost and schedule to our estimates. This is done so that we can improve our planning methodology.
- Although all deliverables have been completed, it is important to ensure that the project records are also completed.
- Everyone working on the project needs to ensure that their records are complete and accurate.

Inputs:
- Decision to close project

Outputs:
- Complete and accurate project records, including a closeout report
- Knowledge gained from completing the project

Roles:
- **Project Engineer** - works with the Schedule Coordinator to closeout the project files
- **Schedule Coordinator** - works with project personnel to closeout the project files; provides a summary of our degree of success in meeting our estimates
- **Quality Assurance Manager** – writes the closeout report
- **Production Manager** - ensures that Device Service Records are up-to-date
- **All others** - ensure that their records are appropriately closed out

Process Flow Diagram